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# Design and development of Android-Based Clinic Service Application: myclinic

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ABSTRACT

This research addresses the pressing need to enhance healthcare accessibility and efficiency, particularly in the context of increasing demands and challenges in the healthcare sector. The background problem lies in the limited accessibility and inefficiencies present in traditional healthcare systems, exacerbated by factors such as geographical constraints and resource limitations. To overcome these challenges, this study introduces MyClinic, an innovative application designed to streamline healthcare processes and improve access to clinic service. Utilizing structured methodologies including BPMN, ERD, Use Case Diagram, and Class Diagram, MyClinic is systematically developed to offer clear functionality. Through Black Box Testing, the application's functionality is rigorously validated, demonstrating compliance with specifications and ensuring user satisfaction. By addressing these issues, MyClinic aims to revolutionize healthcare delivery, offering a solution that is efficient, accessible, and user-friendly. This research highlights the critical role of technology in addressing healthcare challenges and underscores the potential of innovative solutions like MyClinic to transform healthcare delivery in the digital age.



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## 1. INTRODUCTION

In this era of globalization, technology are developing rapidly, especially in the field of information and communication (Dewi, Chen, & Christanto, 2023). The advancement of technology brings benefits to human life (Sutresno, et al., 2023). The role of information technology also affects the competitiveness of an organization to provide the best services (Christanto, et al., 2024), one of which is in the field of healthcare such as clinics.

Clinics are one of the facilities that provide healthcare services, offering basic or specialized medical services, conducted by more than one type of healthcare professional and led by a medical practitioner. The existence of clinics is crucial and they are also required to continuously evolve with the changing times (Qudah & Luetsch, 2019). This necessitates clinics to be managed with good management, especially to meet the needs of the community in the post-Covid-19 pandemic era (Han & Zo, 2023).

A thorough literature study has been conducted previously discussing various aspects related to the development of an Android-based clinic service application, particularly in the context of MyClinic. Previous research has highlighted that mobile applications can significantly enhance the accessibility of healthcare services, especially in remote areas (Luqman & Khan, 2021). MyClinic, with its focus on sustaining healthcare services in the digital era, is expected to overcome geographical limitations that often serve as a major barrier for communities in need of medical care.

Operational efficiency and patient data management have also been the focus of literature research. These studies indicate that Android-based health applications can accelerate administrative processes (Pashazadeh & Navimipour, 2018), minimize waiting times, and improve patient data accuracy (Chen, Lin, & Wu, 2020). Therefore, MyClinic is expected to make a positive contribution to enhancing clinic operational efficiency and patient data management. Patient participation in the treatment process is an important aspect found in the literature (Lee, Ahn, & Lee, 2022). Health applications like MyClinic have the potential to enhance information transparency, provide better access for patients to their medical history, and ultimately, increase patient engagement in personal health management.

Recent findings on how technology, including clinic service applications, can enhance responsiveness and quality of healthcare services (Susan D. Birkhoff PhD & Helene Moriarty PhD, 2020). MyClinic is expected to provide a faster and more responsive consultation experience. Based on this, clinics must continue to strive for the improvement of human resources and technology so that work can be carried out systematically and purposefully (Dewi, et al, 2024). To achieve this, clinics can implement technology in the form of an online service system accessible to all segments of society. Therefore, an online clinic innovation named MyClinic has been developed.

The MyClinic application is not only aimed at providing technological solutions to enhance healthcare services but also to address systemic issues still involving conventional healthcare services. This research aims to make a positive contribution to the evolution of the healthcare system by integrating digital technology into an effective, inclusive, and sustainable service model. Therefore, it is hoped that MyClinic can be a breakthrough that has a real impact on improving healthcare services in this digital era. By systematically developing and testing the MyClinic application using structured methodologies, this research contributes to the body of knowledge related to the design and implementation of innovative healthcare solutions.

## 2. RESEARCH METHOD

This research was conducted using a method involving several careful and structured stages. The stages developed by the researchers include literature review, need analysis, system design and planning, and requirements. Specifically, the system design and planning stage was carried out using the waterfall method. For a clearer understanding of the method used in this research, please refer to Figure 1.

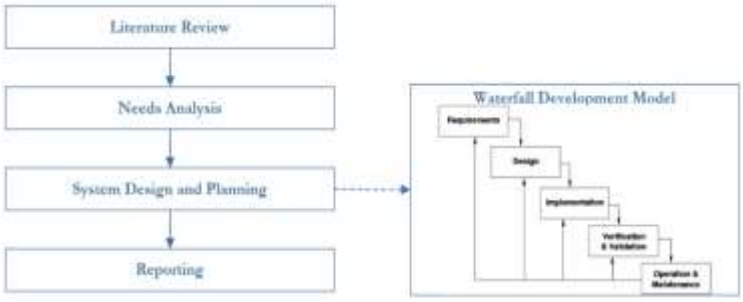


Figure 1. Research Method

In the literature review stage, researchers meticulously collected, assessed, and analyzed pertinent literature pertaining to the research topic. This process entails sourcing, evaluating, and synthesizing scholarly material, where researchers identify crucial literature, distill findings, assess credibility, and pinpoint existing gaps in knowledge. Through synthesizing this wealth of information, researchers construct a conceptual framework that serves as a blueprint for their study design. The overarching goal is to comprehensively grasp previous research, uncover any existing knowledge gaps, and delve into the latest trends within the relevant research field. This crucial step lays the groundwork for meticulously designing the research, ensuring that it not only addresses identified gaps but also makes a significant and meaningful contribution to the field at large.

During the need analysis stage, the identification of stakeholders' needs related to the research is involved (Ferdinand, Christanto, & Sereati, 2023). These stakeholders may include anyone who is a primary user of the MyClinic application. This analysis helps the researchers to understand the needs of each stakeholder, enabling the development of MyClinic to provide beneficial solutions for all stakeholders.

The system design and planning stage involve the design and development of the MyClinic application using the waterfall method. The waterfall method consists of several sub-stages: requirement, design, implementation, verification & validation, and operation & maintenance (Thesing, Feldmann, & Burchardt, 2021). This stage begins with the detailed identification of the system development requirements, including the preparation of necessary tools. Next, a detailed system architecture design for the MyClinic application is created using Business Process Modelling Notation (BPMN), Data Flow Diagram (DFD), Entity Relationship Diagram (ERD), and various diagrams in the Unified Modeling Language (UML) such as Use Case Diagram and Class Diagram. From the designed system architecture, it proceeds to transform into program code and application interface in the form of a prototype (Ardhianto, et al., 2023). The application is built using the Java programming language with the Android Studio tool. The application database uses MySQL database assisted by the implementation of RESTful Web Service as a bridge between the application and the database. After the prototype application is formed, functionality and system performance testing are conducted to ensure that each system component meets specifications and that the system as a whole meets user requirements. Functionality testing in the research is performed using Test Case, where tests are conducted with a series of execution scenarios to determine if the modules being developed meet specifications (Sutresno, et al., 2024). After implementation, the system enters the operational stage. This involves routine maintenance, updates, and issue handling. Maintenance may involve bug fixes, functionality enhancements, and security updates.

The research process concludes with the reporting stage, where the findings and results of the research are systematically organized in a research report. This report includes the problem background, objectives, methodology used, interpretation of results, and practical implications of the research. The entire methodology provides a robust framework for producing valid and accountable research.

## 3. RESULTS AND DISCUSSIONS

### 3.1 Business Process Modelling Notation (BPMN)

BPMN, short for Business Process Model and Notation, is an industry standard used to document, design, and communicate business processes visually (Chinosi & Trombetta, 2012). BPMN provides rich and structured notations and symbols to depict business processes clearly and comprehensively, catering to both business and technical stakeholders. With BPMN, users can illustrate the workflow of a business process from start to finish, including activities, decisions, loops, and information flows within it (Hassen, Turki, & Gargouri, 2022).

BPMN enables modelers to capture important details in business processes, such as who is responsible for each activity, the sequence of activities, as well as the flow of information and decisions within the process (Corradini, et al., 2018). Standardized BPMN notation makes it easily understandable by various parties involved in business processes, ranging from executive management to technical software development teams (Delgado, Calegari, García, & Weber, 2022). Thus, BPMN facilitates better collaboration among different departments and stakeholders within an organization to improve understanding, efficiency, and effectiveness in executing business processes (Pufahl, Zerbato, Weber, & Weber, 2022).

In the MyClinic BPMN as seen in Figure 2, patients are prompted to log in first to select services. At the beginning, patients will be given two options: to request an ambulance or choose other services. All types of services will be confirmed according to the actual conditions/situations, such as ambulance availability, oxygen, medications, and doctors. Patients can consult with doctors either online or offline. For vaccinations, as well as medication and oxygen orders, patients are required to come to the clinic to collect their orders.

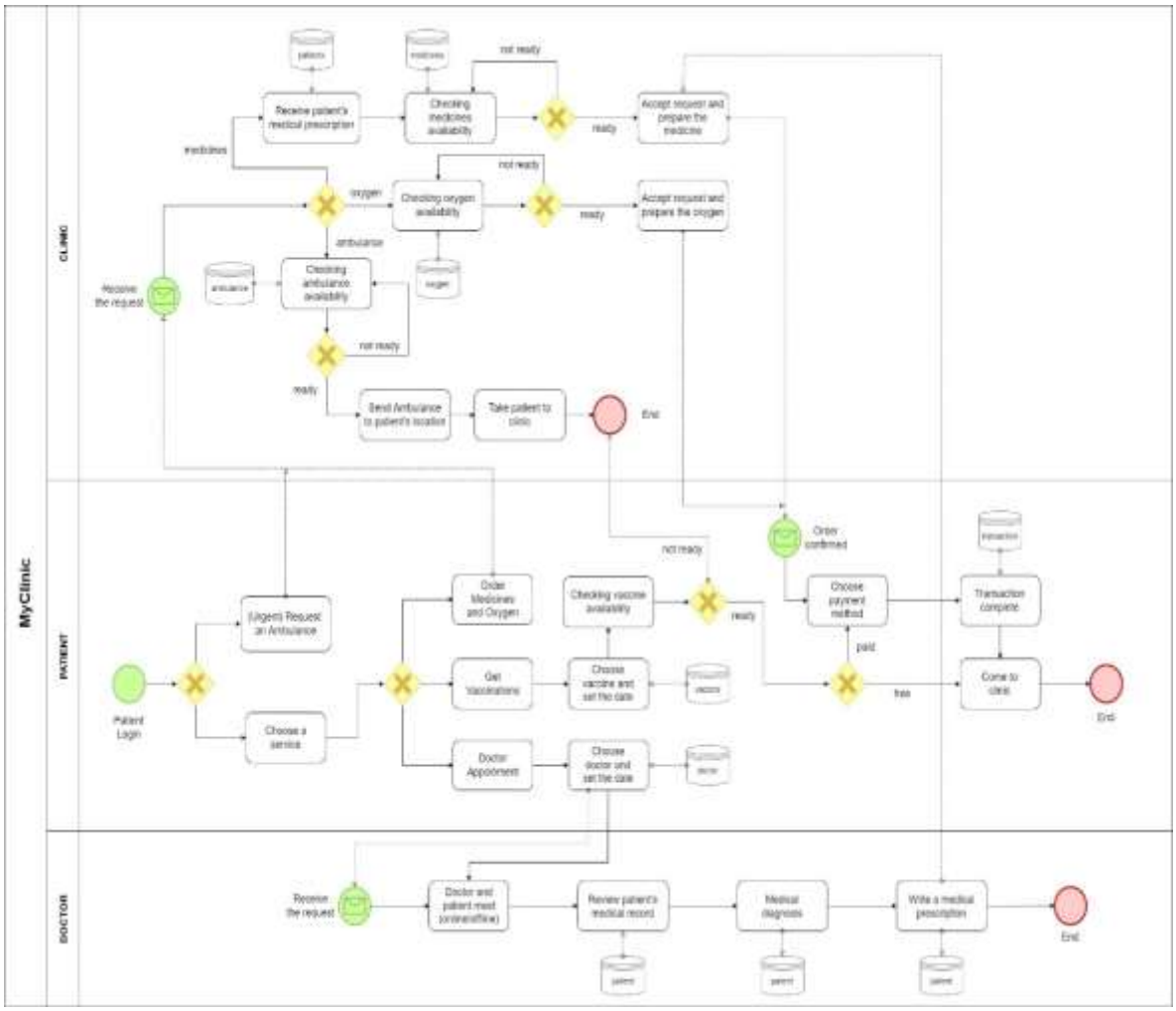


Figure 2. BPMN

3.2 Entity Relationshiop Diagram (ERD)

Entity-Relationship Diagram (ERD) is a visual tool used in software engineering to depict the data structure and relationships between entities in an information system. ERD utilizes symbols such as entities, attributes, and relationships to illustrate how data is stored in a database and how these entities interact with each other (Chilton, 2006). This diagram aids in modeling the database clearly and structurally, enabling stakeholders to understand and design data structures more efficiently (Adi & Kristin, 2014).

ERD typically consists of entities, which represent objects in the database such as people, places, or other business objects; attributes, which represent characteristics or properties of these entities; and relationships, which depict the connections between these entities. By using ERD, database designers can visualize data requirements, identify normalization needs, and design a database schema that meets the system's requirements (Togatorop, Simanjuntak, Manurung, & Silalahi, 2021). This makes ERD an important tool in software development and effective database management.

In Figure 3, you can see the Entity-Relationship Diagram (ERD) of the MyClinic application, which consists of several main entities that can also act as master data, namely Patient, Doctor, Residence, Room, Medicine, Disease, Allergy, Vaccine, and several other entities. In addition, there are also several supporting entities that act as transactional history data such as VaccineRegistration, MedicineOrder, DoctorReservation, OxygenOrder, and several other entities.

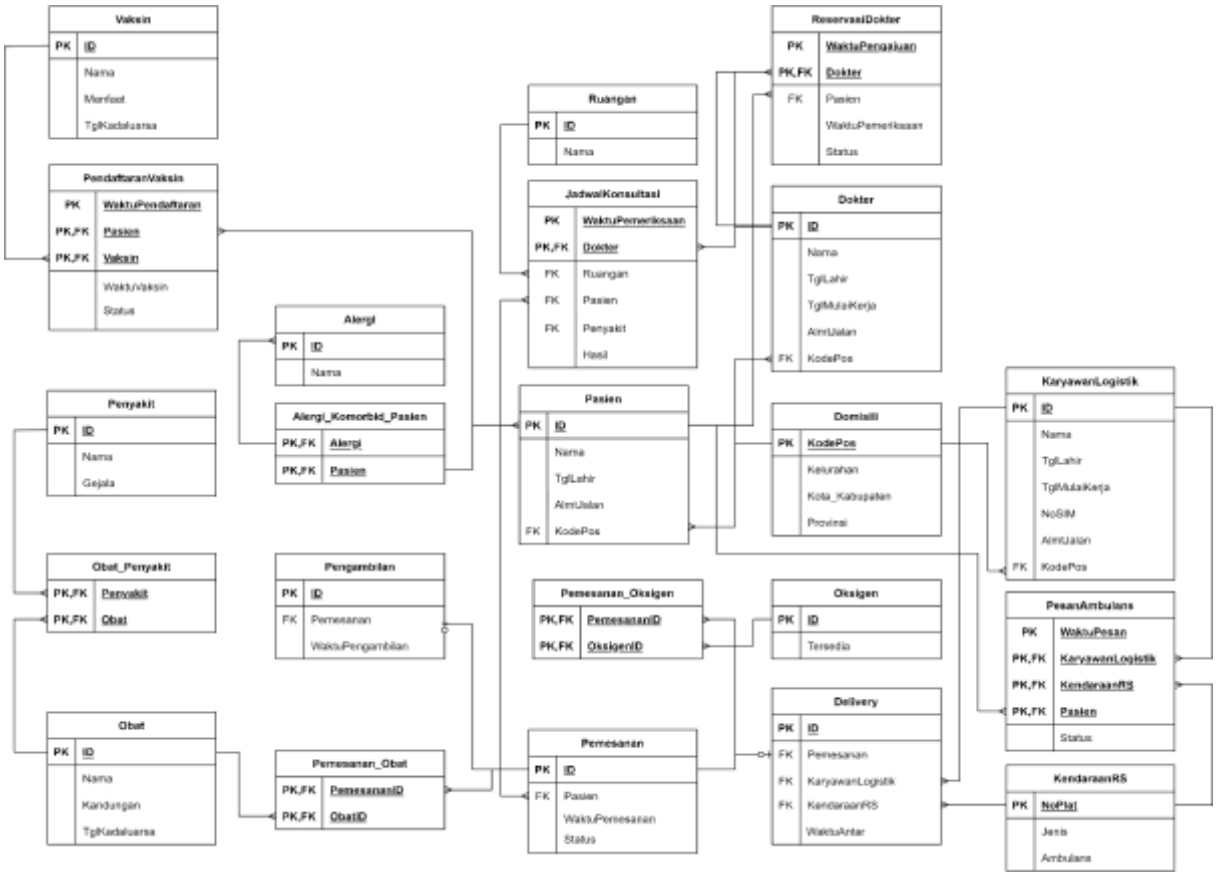


Figure 3. ERD

3.3 Use Case Diagram

A Use Case Diagram is one type of diagram in software engineering used to illustrate the interactions between the system being developed and the actors involved in

that system (Setiyani, 2021). These actors can be users, external systems, or other entities interacting with the system. The Use Case Diagram uses ovals to represent use cases, which depict the functions or actions that actors can perform within the system (Elallaoui, Nafil, & Touahni, 2018). The relationship between actors and use cases is represented by arrows depicting actions or scenarios.

Use Case Diagram helps in understanding the functional requirements of the system by identifying the main functions desired by users or other actors. By visually modeling interaction scenarios between actors and use cases, developers can design and implement systems while considering user requirements more effectively (El-Attar, 2019). Additionally, the Use Case Diagram serves as an effective communication tool between developers and stakeholders, enabling them to collaborate in designing systems that better meet business needs (Cvetković & Cvetković, 2019).

Below is the Use Case possessed by the MyClinic system as seen in Figure 4. There are four main actors: patients, clinic admins, as well as doctors associated with the clinic. Through this Use Case diagram, the Patient has several privileges such as logging into the application, ordering oxygen or medication, requesting an ambulance, scheduling vaccinations, making appointments with doctors, and paying bills through the application.

The clinic admin has privileges to log into the app, create bills, receive ambulance and oxygen requests, and view patient locations in order to fulfill ambulance requests. Meanwhile, users/patients have privileges to log into the app, purchase medication, request an ambulance, schedule vaccinations and appointments with doctors, and pay bills online. Lastly, for doctors, they have privileges to review patient medical reports, prescribe medication, and meet with patients.

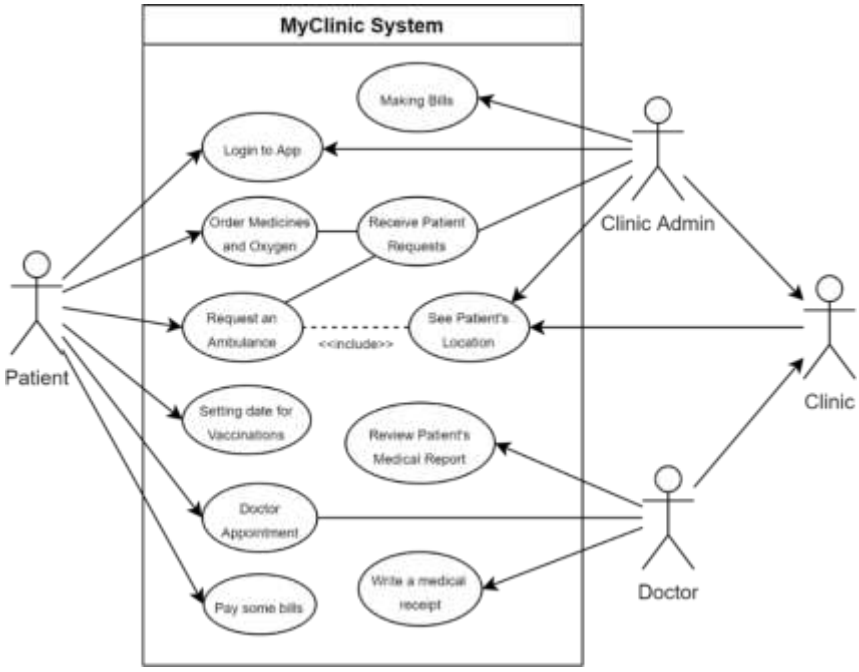


Figure 4. Use Case Diagram

3.4 Prototyping

The MyClinic application is built using Android Studio tools following the guidelines from the previously created BPMN, ERD, Use Case Diagram, and Class Diagram. Several application pages were created starting from the registration page,

profile, doctor selection, vaccination, online chat, to payment. The application starts by displaying the login page in Figure 6a, where the patient, acting as the user, is asked to enter the email and password registered in the application through the sign-up page in Figure 6b. After successful login, the main page will be displayed as shown in Figure 6c.


(a) (b) (c)

Figure 6. Prototype MyClinic Application (a) Login Page (b) Sign Up Page (c) Home Page

In Figure 6, it can be seen that users can choose from the menu to select medication, doctors, vaccinations, oxygen, or emergency assistance such as ambulance. In the doctor selection, users can freely choose a doctor with detailed specifications as shown in Figure 7a. For vaccine selection, users can request the process by filling in several data such as vaccination date, full name, ID number, and gender as shown in Figure 7b. In case of emergency, users can request assistance through the application by providing some data and there are also options related to purchasing oxygen and using ambulance service as depicted in Figure 7c.


(a) (b) (c)

Figure 7. Prototype Aplikasi MyClinic (a) The Doctor Selection Page (b) Vaccine Request Page (c) Emergency Request Page

To facilitate users, the application provides a chat feature as shown in Figure 8a and a history feature as shown in Figure 8b. The chat feature allows users to chat directly with doctors for consultations or to ask questions to Customer Service, such as about medication availability. Meanwhile, the notification feature contains all information

related to news and activities within the application. The application also provides various payment methods such as cash, OVO, Gopay, DANA, Bank Transfer, and Health BPJS as seen in Figure 8c. However, the online payment feature is still under development, so the feature is not yet fully functional and is still in the form of a display only, as it still requires integration with various parties such as banks to be usable.


(a) (b) (c)

Figure 8. Prototype MyClinic Application (a) Chat/Message Page (b) Notification Page (c) Payment Method Page

The prototype application underwent the functional testing process with various Test Cases using the Black Box Testing method. Black Box Testing is a software testing method in which the system is tested without considering the internal implementation details. This approach treats the system as a "black box" where testing is conducted based on functional specifications and expected input-output, allowing for the detection of errors or bugs in the system's functionality without needing to know the internal implementation details (Felício, Simão, & Datia, 2023). There are a total of 87 test cases summarized as shown in Table 1.

Table 1. Black Box Testing

| No | Page | Testing Scenario | Expected Outcome | Testing Result | Conclusion |
|---|---|---|---|---|---|
| L1 | Login | Field Email and Password are left empty, then click the Login button | The system will display an error message "Cannot be empty!" | The error message "Cannot be empty!" appears | Valid |
| L2 | Login | Field Email and Password are filled randomly, then click the Login button | The system will display an error message "Incorrect Email or Password!" | The error message "Incorrect Email or Password!" appears | Valid |
| L3 | Login | Field Email and Password are filled with registered credentials, then click the Login button | The page will be redirected to the Home page | The page is redirected to the Home page | Valid |
| V1 | Vaccine Request | Date is not selected and all fields are left empty, then click the Send Request button | The system will display an error message "Cannot be empty!" | The error message "Cannot be empty!" appears | Valid |
| V2 | Vaccine Request | Request Date is selected, Full Name and Gender fields are filled, and the NIK field is filled with less than 16 characters, then click the Send Request button | The system will display an error message "NIK must be 16 characters!" | The error message "NIK must be 16 characters!" appears | Valid |
| V3 | Vaccine | Request Date is selected for | The system protects from | Cannot select | Valid |

| | | | | | |
|---|---|---|---|---|---|
| | Request | yesterday and all fields are filled, then click the Send Request button | selecting a date that has passed | yesterday's date | |
| V4 | Vaccine Request | Request Date is selected and all fields are filled correctly, then click the Send Request button | The system will send the request data, receive a notification, and the page will be redirected to the Request List page | Receive notification and redirect to the Request List page | Valid |

In Table 1, the results of Black Box Testing are summarized for the Login and Vaccine Request pages, totaling 7 test cases that received valid results. Upon overall examination of the total 87 test cases, all results are valid. Therefore, the overall success rate of Black Box Testing for the MyClinic application is 100%.

### 3.5 Discussion

The results of the research have yielded an application with various and more diverse features compared to other clinic applications previously developed. MyClinic is not just an ordinary application; it also brings innovation by providing several unique features that are highly beneficial to users (Pashazadeh & Navimipour, 2018). One of the distinctive features of this application is the ability to order oxygen cylinders online. This feature is crucial for patients in need of additional oxygen as it allows them to obtain supplies more easily and quickly. Additionally, MyClinic also offers ambulance booking services, which can be utilized in emergency situations where immediate medical transportation is required. This helps improve patient accessibility to emergency medical services more efficiently.

Another notable feature of MyClinic is its capability to facilitate online vaccine registration. With this feature, users can easily register to receive vaccines through the application, without the hassle of visiting healthcare centers in person. This not only simplifies the registration process but also helps enhance vaccination coverage in the community by providing easier access for individuals seeking vaccination. With these features in place, communication between users and hospitals becomes more open and efficient (Qudah & Luetsch, 2019). Outpatients can easily access the medical services they need through this application without having to physically visit the hospital. This not only helps reduce waiting times and travel costs for patients but also aids in optimizing hospital resource utilization by facilitating more effective patient management.

In addition to being a healthcare application, MyClinic serves as a pioneering solution that revolutionizes healthcare accessibility and delivery. Its multifaceted features empower users to proactively manage their health while facilitating seamless communication with healthcare providers. Through ongoing feature development and enhancements, MyClinic endeavors to set new benchmarks in healthcare technology, ensuring its relevance and effectiveness in addressing evolving healthcare needs.

## 4. CONCLUSION

This research has successfully produced the MyClinic application, a platform aimed at improving accessibility and efficiency of healthcare services. By using structured methodologies such as BPMN, ERD, Use Case Diagram, and Class Diagram, the application has been designed with an organized structure and clear functionality. The use of Black Box Testing in testing the application's functionality has shown satisfactory results, confirming that all features operate according to specifications and provide a satisfying user experience. With successful functional testing results, MyClinic is ready for release to users. This indicates that the application has gone through adequate development and testing stages, and is ready to be an effective solution in providing easily accessible and efficient healthcare services. The success of this research brings hope that MyClinic can be a valuable tool in improving the quality of life for communities through the use of technology in the healthcare sector.

It is expected that the MyClinic application will have a positive impact in improving access to healthcare services, and thus contribute to the overall well-being of the community. This conclusion confirms that this research has the potential to make a significant contribution to the development of better healthcare services in the digital era, and to provide innovative and efficient solutions to public health needs. However, there remain several avenues for future research to further amplify its effectiveness and impact. Firstly, optimizing user experience through comprehensive usability testing could refine interface design and navigation, ultimately enhancing user satisfaction. Secondly, integrating MyClinic with telemedicine services could expand its capabilities, enabling real-time video consultations and remote monitoring for more comprehensive patient care. Lastly, assessing the long-term impact of MyClinic on healthcare outcomes and patient satisfaction through longitudinal studies would provide valuable insights into its effectiveness and sustainability. By addressing these research areas, future studies can propel the development and implementation of MyClinic, ultimately advancing healthcare services in the digital era and promoting better health outcomes for communities.

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